## Centre report of KMA 28<sup>th</sup> WGNE meeting Toulouse 5-9 Nov. 2012

## Hoon Park Numerical Model Management Office KMA



## **Outlines**

- Current status & update strategy of KMA NWP system
- Upgrade NWP system in 2012 and upcoming plans
- Status & future plan for new model development project(KIAPS)



# Status & upgrade strategy



# **HPC Environment**



## Operational NWP Models ('12.5~)

	Model	Resolution	Target Length	Main target
Global	UM (Global)	N512(25km) L70	252 hours 72hours	Medium-range
		N320 L70	240 hours	Medium-range (EPS)
E-Asia	UM (E.Asia)	12km L70	72 hours	Short-range
	WRF (E.Asia)	10km L40	72 hours	Short-range
Local	UM (Korea)	1.5km L70	24 hours	Very short-range
	KLAPS (Korea)	5km	12 hours	Very short-range
App. & Stat.	Wave Watch III	30km	252 hours	Global
		8km	72 hours	Regional
		1km	24 hours	Coastal
	ADAM (Dust & Aerosol)	30km	72 hours	Asia dust
	DBAR (Typhoon)	35km	72 hours	Track
	Tide/Storm Surge	9km	72 hours	East Asia



# Update strategy for NWP system

Year	2013	2014	2015	2016
computer	3 <sup>rd</sup>		3 <sup>rd</sup> to 4th	4 <sup>th</sup>
Global Deterministic	25km 70L Hybrid 4dVar - 60km inner loop	<b>16km 85L Hybrid 4dVar</b> - 48km inner loop	<b>16km85L Hybrid 4dVar</b> - 48km DA inner loop	16km 90L Hybrid 4dVar
Global Ensemble	40km 70L 22/44M O 6 hour cycle	40km 70L 22/44M Extended forecast ocean coupling	32km 85L 22/44M	32km 85L 44M
Local (LDAPS)	1.5km 70L 3dVar O 1hr cycle O COMS AMV O Ground GPS	<b>1.5km 70L 3dVar(1hr)</b> O Radar reflectivity	<b>1.5km 70L 3dVar(1hr)</b> O 12/22 member ENS O rain rate, cloud	1km 70L 3dvar(1hr) M22

UndeterminedCoupling with ocean wave, Asian dust model with global model



# Update NWP system in 2012



## **Global DA updates**

#### OBS data usage

- METAR, CSR from Europe, Use AIRS data over land
- Improve RH, ASCAT for soil moisture

#### Data Assimilation

♦ Enhance inner loop: 90km (N144)  $\rightarrow$  60km (N216)



## Computational change for global

#### Configure dedicated I/O server(IOS) for model output





## Use of Korea Geostationary Sat. (COMS)

- 15min interval imageries
- Stable INR(image navigation and registration)
- Local Area scans between ENH



КМА

## Use of COMS AMV for Global

- 2011.9.1~10.31 (00,12UTC)
- overall positive impact)
- RMSE diff & improvement
- Up to 2% improvement in EA





- Forecast sensitivity to observation for 3 months (2012.07~09)
- COMS AMV
  - covers 7% of total AMV impact
  - Larger impact from Vis AMV
  - Relatively smaller impact at mid-atm (300~700 hPa)
  - Larger IR and Vis impact

## Clear Sky Radiance(CSR) of COMS

- CSR data of WV channel (6.75 μm)
- 2012.6.11 ~ 2012.7.10 (1 month)

Verification against analysis for 5 days forecast











## Step forward for COMS Data

- For AMV
  - Target Size 24x24 pixel to 16x16 (96km to 64km)
  - Application of expected error (EE) for QC
  - Usage of VIS. 1km AMV and SWIR AMV
  - Update OBS error and application to D.A.
- For COMS CSR
  - Modification of thinning strategy and improve cloud masking
  - Bias and Observation error monitoring
  - Preparation of hourly data for regional and local model
    - Pixel based CSR (or 3x3 pixels) for local model (1.5km resolution)
    - For local model, limited number of OBS, especially in night



## LDAPS (Local Data Assimilation and Prediction System)



- Model : Unified Model (currently vn7.9)
- Grid : Horizontally Variable Grid (inner : 1.5km)

70 Vertical Layers up to ~38km

- Data Assimilation : 3DVAR + FGAT(3 hourly)
- Target Length : 24 hours (with Lateral B.C from Global Model)
- Timestep size : 50 sec
- In Operation since May 2012





## **Rainfall verification**



- Compare new(2012) and previous(2011) version performance
- ETS score slightly improved by using Global boundary condition
- Reduce right rain(<0.1mm) by new</li>



## WMO project Activities

### SWFDP-SeA

- Supporters(Global centers): KMA, JMA, CMA
- Beneficiaries : Vietnam, Thailand, Cambodia, Laos
- Overall support including provision of Ensemble and deterministic NWP output
- through internet, training and technical support, etc.

### RAII project on NWP

- Supporters : KMA, JMA, Hong Kong
- Beneficiaries : All Asian countries
- Provision of NWP output through the internet
- Weather Charts and City specific forecasts for 18 countries 238 cities



## International Supports for Asian/African Countries



# **Upcoming Plans**

#### Data Assimilation

- Implementation of Hybrid 4DVAR system : Operation planned in 2013
  - Collaboration with the Met Office (Adam Clayton as visiting scientist)

### ✤Global EPS

- 6hour cycle system
  - 44 ensemble member (depend on result from member research)
- Extended range forecast(1month)
  - construct extend forecast using ensemble and atmosphere-ocean coupling
- upgrade Local model(LDAPS)
  - 1 hourly FGET of LDAPS for better performance for precipitation forecast
  - more use of local obs. data(ground based GPS, COMS AMV and CSR)
  - use of drift information of radio-sonde data



# Status & plan for KIAPS



## **Dynamic core development**



## Shallow water model result

 Spectral Element/Continuous Galerkin (SE/CG) & Discontinuous Galerkin (DG) on the cubed-sphere Validation Experiments (CG & DG produce identical results)

cosine bell advection

Rossby-Haurwitz wave





# Thank You for attention



## Dynamic core candidate

#### <u>Non-hydrostatic Unified Model of</u> the <u>Atmosphere (NUMA)</u>



cubed-sphere grid

$$\vec{u}_c = \vec{u}_u + \mu \vec{x}$$

where the subscripts c and u denote the constrained and unconstrained horizontal wind velocities, respectively.

$$\vec{u}_c \cdot \vec{x} = \mathbf{0}$$

which results in the Lagrange multiplier  $\vec{x} \cdot \vec{u}_u$ 

25

$$\mu = \frac{x \cdot u_u}{a^2}$$



- ✓ Spectral Element (Continuous Galerkin), DG (Discontinuous Galerkin) method
- ✓ Cubed-Sphere + GLL grid
- ✓ Initial developed by NRL; Naval Research Laboratory) Hydrostatic version (NSEAM; NRL Spectral Element Atmospheric Model)
- NPS; Naval Postgraduate School continue development for Nonhydrostatic version (NUMA)



where a is the radius of the Earth.